jc447 U.S. PTO
10/14/98

Case Docket No. PHB 34,200

THE COMMISSIONER OF PATENTS AND TRADEMARKS, Washington, D.C. 20231

Enclosed for filing is the patent application of Inventor:
OCTAVIUS J. MORRIS and TIMOTHY J. EVERETT

jc523 U.S. PTO
09/172435
10/14/98

For: ENCODED VIDEO SIGNAL FORMATTING

ENCLOSED ARE:

[X] Appointment of Associates;
[X] Information Disclosure Statement, Form PTO-1449 and copies of documents listed therein;
[X] Preliminary Amendment;
[X] Specification (14 Pages of Specification, Claims, & Abstract);
[X] Declaration and Power of Attorney:
(1 Page of a [X]fully executed []unsigned Declaration);
[X] Drawing (2 sheets of [X]informal []formal sheets);
[X] Certified copy of Great Britain application Serial No.9721662.6.
[X] Authorization Pursuant to 37 CFR §1.136(a)(3)
[] Other: ;
[X] Assignment to U.S. PHILIPS CORPORATION.

FEE COMPUTATION

CLAIMS AS FILED				
FOR	NUMBER FILED	NUMBER EXTRA	RATE	BASIC FEE - $790.00
Total Claims	12 - 20 =		X $22 =	
Independent Claims	2 - 3 =		X $82 =	
Multiple Dependent Claims, if any			$270 =	
TOTAL FILING FEE			=	$ 790.00

Please charge Deposit Account No. 14-1270 in the amount of the total filing fee indicated above, plus any deficiencies. The Commissioner is also hereby authorized to charge any other fees which may be required, except the issue fee, or credit any overpayment to Account No. 14-1270.

[]Amend the specification by inserting before the first line as a centered heading --Cross Reference to Related Applications--; and insert below that as a new paragraph --This is a continuation-in-part of application Serial No. , filed .--, which is herein incorporated by reference--.

CERTIFICATE OF EXPRESS MAILING

Express Mail Mailing Label No. EL215004517US
Date of Deposit October 14, 1998
I hereby certify that this paper and/or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. 1.10 on the date indicated above and is addressed to the Commissioner of Patents and Trademarks, Washington, D.C. 20231.

Elissa DeLuccy
Typed Name

Elissa DeLuccy
Signature

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

OCTAVIUS J. MORRIS ET AL

Atty. Docket

PHB 34,200

Serial No.

Filed: CONCURRENTLY

ENCODED VIDEO SIGNAL FORMATTING

Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Sir:

Prior to calculation of the filing fee and examination, please amend the above-identified application as follows:

IN THE SPECIFICATION

Page 1, before line 1, delete "DESCRIPTION" and after the title insert as a centered heading:

--BACKGROUND OF THE INVENTION--;

Page 2, line 24, insert a centered heading:

--SUMMARY OF THE INVENTION--;

Page 5, line 17, insert as a centered heading:

--BRIEF DESCRIPTION OF THE DRAWINGS--;

Page 6, line 4, insert as a centered heading:

--DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS--.

IN THE ABSTRACT

Page 14, before line 5, delete in its entirety and substitute

--ABSTRACT OF THE DISCLOSURE--;

last line, delete "(Figure 2)".

REMARKS

Applicant respectfully requests entry of the foregoing Preliminary Amendment prior to examination of the above-referenced application filed herewith.

Respectfully submitted,

By _____
Laurie E. Gathman, Reg. 37,520
Attorney
(914) 333-9605
October 14, 1998

DESCRIPTION

ENCODED VIDEO SIGNAL FORMATTING

The present invention relates to the formatting of predictive-encoded digital video signals for storage on a recording medium, especially but not exclusively an optical or magnetic disc, as well as to storage media carrying the particularly formatted signals, and encoding and decoding apparatus supporting the particular signal format.

With reference to predictive encoding, we are principally concerned with the MPEG coding schemes as defined in ISO 11172 (MPEG-1) and ISO 13818 (MPEG-2), although it will be recognised that it is applicable to other coding schemes, particularly motion-compensated and hybrid-DCT (discrete cosine transformation) based coding schemes, such as the H.261 and H.263 standards for video-telephony. MPEG and H.261 are digital coding systems conventionally used for storing and compressing natural picture sequences, with the decoders being designed to interpret such encoded data and reproduce the same original sequence of images.

The MPEG standard recognises three types of pictures (frames) namely intra-pictures, predicted pictures and interpolated pictures, generally referred to as I-, P-, and B-pictures respectively. A typical MPEG picture sequence is shown in Figure 1 of the accompanying drawings. I-pictures are specifically intended to provide access points for random pictures and as such they are coded complete, with only limited compression. P-pictures are coded with reference to a past (I or P) picture and often form a reference for future P-pictures. B-pictures have the highest degree of compression but require both a past and future reference for their generation.

MPEG compressed video stored on an optical or magnetic disc (CD, DVD, DVD-RAM, hard-disk etc.) or other linearly-read digital storage means may be seen as a replacement for analog video storage systems such as video tape and laser disc. One of the known problems with using predictively coded video is how to implement the so-called trick modes that users take for granted (fast-forward and reverse play being the best known examples). As it is not generally possible to speed up or reverse the conventional display process, it becomes necessary to skip through the encoded data, at the same time seeking suitable access points: in the Figure 1 example, it is only possible to start decompressing the video data stream at the points indicated, where the I-frames do not rely on contributions from prior to the access point.

The step of locating these access points brings another problem, in that the compressed frames in the sequence are of varying lengths and hence the procedure involves more than simply counting bits from the start of a previous frame. Some systems solve the problem by introducing data into the video stream with pointers to future access points (as I-frames are indicated in DVD-Video). One example of such a system is described in GB-A-2308264 where an MPEG disk for high-speed reproduction contains position information for successive I-frames in a recording area of a first I-frame. The problem with this approach is that a second pass is needed to fill in these pointers. This makes real-time recording (one pass as with conventional VCR) impossible.

It is therefore an object of the present invention to provide a means whereby predictively-encoded digital video signals may be decompressed in one or various trick-play modes.

In accordance with a first aspect of the present invention there is provided a method for formatting a sequence of video images comprising

the steps of: encoding successive images of the sequence according to a predetermined coding scheme in which some images of the sequence are intra-coded, without reference to any other image of the sequence, and the remainder are respectively coded with reference to at least one further image of the sequence; formatting the encoded data for each image frame into one or a sequence of data blocks and outputting a data block stream formed of the data block or blocks from successive ones of the sequence of video images; characterised in that the step of formatting comprises the further steps of identifying intra-coded frames and of inserting additional data blocks in said data block stream, each of said additional blocks carrying data identifying the relative location in the data block stream of the first or only data block of an intra-coded image frame.

Preferably, a single additional data block (also referred to herein as an information block) is inserted in the data block stream at fixed periodically repeated intervals, such as for example every 25th data block of the stream; where the data blocks are all of a common size, skipping from one information block to another becomes a relatively simple matter. Each additional data block may store data identifying the first or only data block in the data block stream of the closest previously formatted intra-coded image frame, and may also store further data identifying the length of the said closest previously formatted intra-coded image frame. As above, the image frames may be encoded in accordance with MPEG standards, or another predictive coding scheme may be employed.

Also in accordance with the present invention there is provided a sequentially-readable storage device carrying an encoded and formatted sequence of video image frames wherein some images of the sequence are intra-coded, without reference to any other image of the sequence, and the remainder are respectively coded with reference to at least one further image of the sequence, and the encoded data for the succession of

image frames is formatted into a sequence of fixed size data blocks, with at least one data block per encoded image frame, with the stored sequence of data blocks including additional data blocks, with each such additional data block identifying the storage device storage location of the first or only data block of an intra-coded image frame.

Within the storage device, the said additional data blocks are suitably provided at fixed periodically repeated intervals within the stored sequence of encoded image data blocks, with each said additional data block containing data identifying the storage device storage location of the first or only data block of the closest previously formatted intra-coded image frame. Where the storage device is an optical disc, the said additional data blocks may identify the location of the first or only data block of the closest preceding intra-coded image frame in terms of the location on disc at which said data block is stored.

Where the storage device carries at respective separate storage locations auxiliary data associated with respective encoded image frames, for example subtitling data, each said additional data block may further carry data identifying the storage device storage location of the auxiliary data associated with the particularly indicated intra-coded image frame. In this way, the auxiliary data may be included in the trick-play.

Further in accordance with the present invention there is provided an encoder apparatus operable to implement the formatting method set forth above, the apparatus comprising means for encoding successive images of a video image sequence according to a predetermined coding scheme in which some images of the sequence are intra-coded, without reference to any other image of the sequence, and the remainder are respectively coded with reference to at least one further image of the sequence; means for formatting the encoded data for each image frame into one or a sequence of fixed size data blocks and outputting a data

block stream formed of the data block or blocks from successive ones of the sequence of video images, said means for formatting being operable to identify intra-coded frames, and being configured to insert additional data blocks in said data block stream, each of said additional blocks carrying data identifying the relative location in the data block stream of the first or only data block of an intra-coded image frame.

Still further in accordance with the present invention there is provided a video image player configured to receive and read the sequence of data blocks from a sequentially-readable storage device as set forth above, said player comprising a decoder arranged to receive the stream of data blocks, decode the image data and output a sequence of video image frames, said player being operable to output selected ones of said sequence in a fast-forward or fast reverse mode, the player comprising means for selecting frames by selecting every N^{th} additional data block and displaying the respectively identified intra-coded image frame.

Further features and advantages of the present invention will become apparent from reading of the following description of preferred embodiments of the invention, given in terms of MPEG compressed video by way of example only, with reference to the accompanying drawings in which:

Figure 1 schematically represents a conventional video frame sequence according to MPEG standards;

Figure 2 represents an MPEG frame sequence formatted as a data block sequence according to the invention;

Figure 3 shows an optical disc holding frame sequences such as that of Figure 2;

Figure 4 is a block schematic drawing of an encoder apparatus

embodying the present invention; and

Figure 5 is a block schematic diagram of a decoder apparatus embodying the present invention.

The method for formatting starts with the encoding of successive images of the sequence as MPEG I-, B-, or P-frames to generate a sequence of encoded frames such as that of Figure 1. Note that fields rather than frames may be the basic encoded entity, although the technique is unchanged: the following example refers just to frames although the skilled reader will recognise that this is not intended as in any way limiting. The formatting operation itself divides the encoded data for each image frame into one, or more usually several, data blocks which would conventionally be output in sequence as a data block stream. For convenience of handling, these data blocks are chosen to be of a common size, although this is not a prerequisite to successful operation.

In order to enable I-frames to be rapidly located, and thus enable trick-modes, additional data blocks (information blocks) are inserted at regular intervals in the data block stream, for example at every 25th or 30th block. The encoded video is embedded within a multiplexed steam when recorded to disc, with the information blocks being classed as "private" data such that a demultiplexer will generally ignore them and thus avoid disturbing the MPEG sequence. Each of these information blocks carries data identifying the starting location (and preferably also length) of the previous I-frame as it appears in the data block stream.

To implement fast-forward through the video frames, a suitably configured player will seek to an arbitrary information block and, using the data therein, locate the preceding I-frame and decode it. Depending on the speed of fast-forward, the player then skips to the next (or Nth) information block and repeats the process, thus skipping through the video

stream at an increased speed. The speed of viewing depends on the number of information blocks skipped as, although the compressed video frames are of variable length, the overall compressed bit rate remains approximately constant.

Figure 2 represents the data block sequence for a video image sequence compressed as:

IBPBPBPBIBPBPBPBI

Each of the letters appearing in the sequence in Figure 2 represents one data block on the storage medium: as can be seen, the I-frames (being coded complete) require the greatest number of data blocks for recording. As also shown, the sequence is interrupted every 25th block by the inclusion of an information block (represented by **i**) with arrows 10,12 representing how the information block identifies the first data block of the immediately preceding I-frame.

Figure 3 represents a sequentially-readable storage device, in the form of a DVD disc 14, carrying the encoded and formatted sequence of video image frames. The disc has the conventional centre hole 16 and clamping area 18 surrounded by a pair of read-out surfaces 20 provided by respective transparent substrates 22 over recorded layers 24, with the upper and lower layers being separated by an adhesive layer 26. As schematically shown, within the recorded tracks, the periodically spaced information blocks 28 contain the location of the start of the preceding I-frame 30.

Figure 4 schematically represents an encoding and formatting apparatus operable to generate the streams of data blocks such as that in Figure 2. From an image data source 40 an MPEG encoder 42 generates the compressed I-, P-, and B-frame data and outputs it to frame data store 44. As the data is read into the frame data store, it is also passed to a monitoring stage 46 which detects I-frames. Coupled to read the data out

of the frame data store 44 is formatting stage 48 which forms the sequential stream of data blocks: the formatting stage is also coupled to receive indication of I-frames from the monitoring stage 46 and, based on this information, it generates the periodic information frames and inserts them in the output block stream to a storage apparatus write/recording stage 50.

Figure 5 schematically represents a video image player configured to receive and read the sequence of data blocks, including information blocks, from a suitable sequentially-readable storage device such as the disc of Figure 3. The player comprises a disc reader 60 operating under control of a CPU 62 to read data from disc 14 to decoder stage 64 (via the CPU). In the decoder stage 64, coupled with a frame store 66, the video image sequence is recreated in the frame store before being output to a display, such as a television 68.

User input means 70 are coupled with the player CPU 62 and include controls for initiating the various trick-modes supported: as will be well understood, these controls may be provided on the player itself or on a remote control handset coupled by infra-red link. On entering a trick-mode, such as fast-forward, the CPU directs the decoder 64 to skip frames by selecting every N^{th} additional data block and displaying just the respectively identified I-frame. In a domestic appliance, the value of N may be fixed (constant fast-forward/reverse rate): in professional/studio apparatus, however, it may be variable in response to user input.

Whilst shown in Figures 4 and 5 as hardware devices, it will be understood that the encoding and decoding procedures may be carried out off-line wholly or partially in a software implementation.

From reading the present disclosure, other modifications will be apparent to persons skilled in the art. Such modifications may involve other features which are already known in the design, manufacture and

use of video signal encoding and decoding systems and devices and component parts thereof and which may be used instead of or in addition to features already described herein. Although claims have been formulated in this application to particular combinations of features, it should be understood that the scope of the disclosure in the present application also includes any novel feature or any novel combination of features disclosed herein either explicitly or implicitly or any generalisation thereof, whether or not it relates to the same invention as presently claimed in any claim and whether or not it mitigates any or all of the same technical problems as does the present invention. The applicants hereby give notice that new claims may be formulated to such features and/or combinations of such features during the prosecution of the present application or of any further application derived therefrom.

CLAIMS

1. A method for formatting a sequence of video images comprising the steps of:

encoding successive images of the sequence according to a predetermined coding scheme in which some images of the sequence are intra-coded, without reference to any other image of the sequence, and the remainder are respectively coded with reference to at least one further image of the sequence;

formatting the encoded data for each image into one or a sequence of data blocks and outputting a data block stream formed of the data block or blocks from successive ones of the sequence of video images;

characterised in that the step of formatting comprises the further steps of identifying intra-coded frames and of inserting additional data blocks in said data block stream, each of said additional blocks carrying data identifying the relative location in the data block stream of the first or only data block of an intra-coded image frame.

2. A method as claimed in Claim 1, wherein a single additional data block is inserted in said data block stream at fixed periodically repeated intervals.

3. A method as claimed in Claim 1, wherein each additional data block stores data identifying the first or only data block in the data block stream of the closest previously formatted intra-coded image frame.

4. A method as claimed in Claim 3, wherein each additional data block stores further data identifying the length of the said closest previously formatted intra-coded image frame.

5. A method as claimed in Claim 1, wherein the image frames are encoded in accordance with MPEG standards and all data blocks in the data block stream are of a common size.

6. A storage device capable of being sequential read and carrying an encoded and formatted sequence of video image frames wherein some images of the sequence are intra-coded, without reference to any other image of the sequence, and the remainder are respectively coded with reference to at least one further image of the sequence, and the encoded data for the succession of image frames is formatted into a sequence of data blocks, with at least one data block per encoded image frame, with the stored sequence of data blocks including additional data blocks, with each such additional data block identifying the storage device storage location of the first or only data block of an intra-coded image frame.

7. A storage device as claimed in Claim 6, wherein the said additional data blocks are provided at fixed periodically repeated intervals within the stored sequence of encoded image data blocks, and all data blocks are of a common size.

8. A storage device as claimed in Claim 6, wherein each said additional data block contains data identifying the storage device storage location of the first or only data block of the closest previously formatted intra-coded image frame.

9. A storage device as claimed in Claim 8, carrying at respective separate storage locations auxiliary data associated with

respective encoded image frames and each said additional data block further carries data identifying the storage device storage location of the auxiliary data associated with the particularly indicated intra-coded image frame.

10. A storage device as claimed in Claim 8, in the form of an optical disc, wherein the said additional data blocks identify the location of the first or only data block of the closest preceding intra-coded image frame in terms of the location on disc at which said data block is stored.

11. An encoder apparatus operable to implement the method of Claim 1, said apparatus comprising means for encoding successive images of a video image sequence according to a predetermined coding scheme in which some images of the sequence are intra-coded, without reference to any other image of the sequence, and the remainder are respectively coded with reference to at least one further image of the sequence;

means for formatting the encoded data for each image frame into one or a sequence of data blocks and outputting a data block stream formed of the data block or blocks from successive ones of the sequence of video images, said means for formatting being operable to identify intra-coded frames, and being configured to insert additional data blocks in said data block stream, each of said additional blocks carrying data identifying the relative location in the data block stream of the first or only data block of an intra-coded image frame.

12. A video image player configured to receive and read the sequence of data blocks from a sequentially-readable storage device as claimed in Claim 6, said player comprising a decoder arranged to receive

the stream of data blocks, decode the image data and output a sequence of video image frames, said player being operable to output selected ones of said sequence in a fast-forward or fast reverse mode, the player comprising means for selecting frames by selecting every N^{th} additional data block and displaying the respectively identified intra-coded image frame.

ABSTRACT

ENCODED VIDEO SIGNAL FORMATTING

A method and apparatus are provided to enable variable speed forwards or reverse play of motion-prediction coded sequences of video signal frames. Successive images of a sequence are MPEG encoded with some images of the sequence becoming I-frames and the remainder P- or B-frames. The frame data is formatted to sequences of fixed size data blocks (I,P,B) to form a data block stream into which further, information, blocks (i) are inserted at periodic intervals. Each information block (i) carries a pointer to the relative location in the data block stream of the first data block of the immediately preceding I-frame.

(Figure 2)

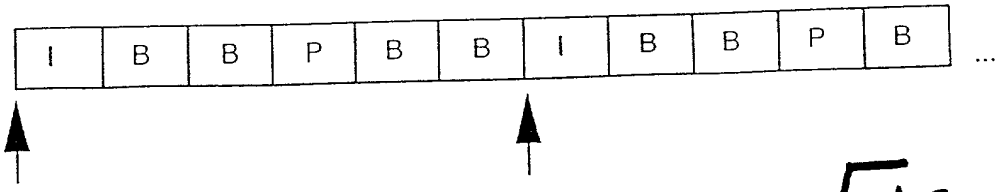


FIG. 1
(PRIOR ART)

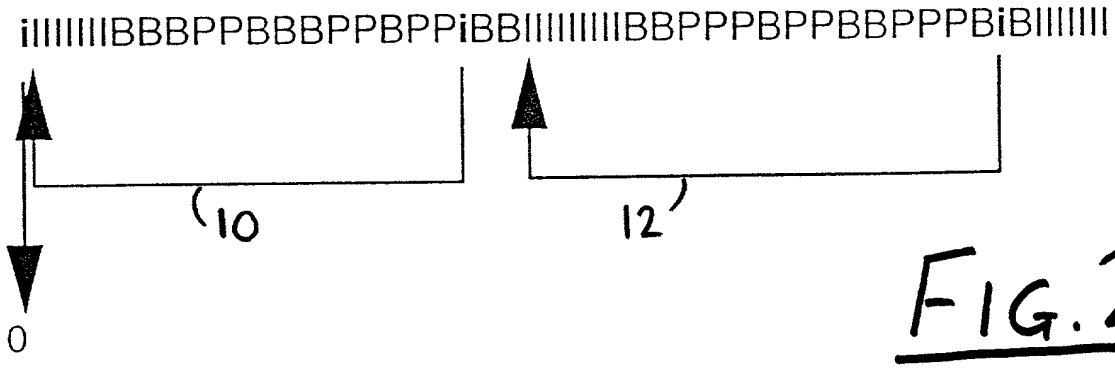


FIG. 2

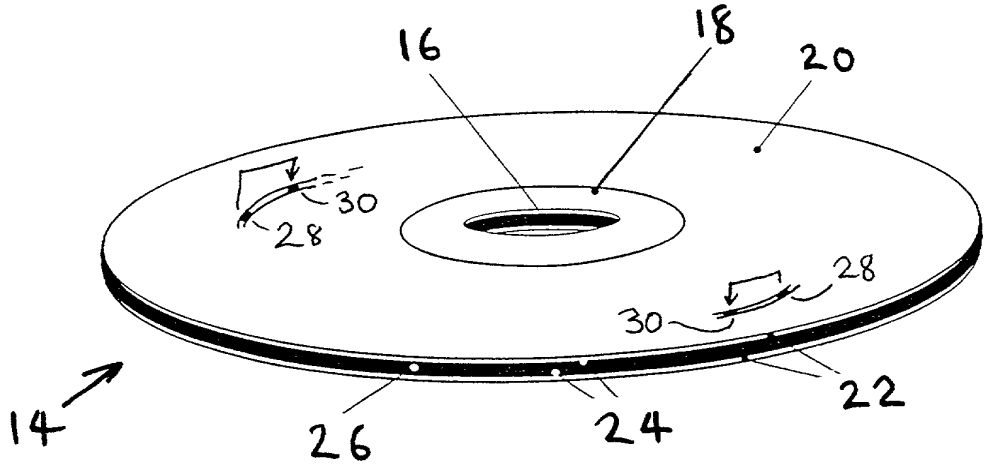


FIG. 3

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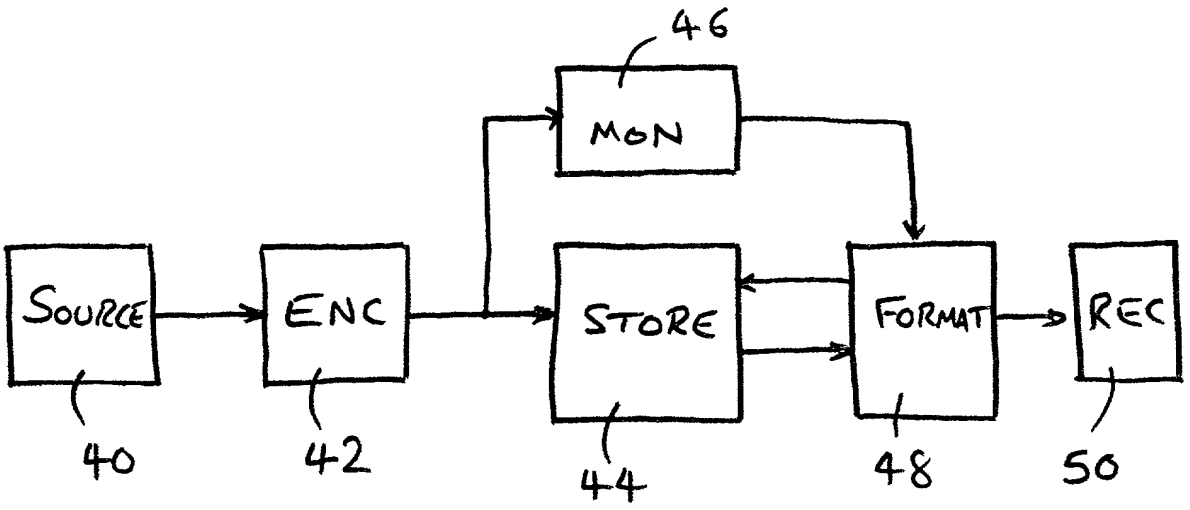

46
MON
SOURCE
ENC
STORE
FORMAT
REC
40
42
44
48
50

FIG.4

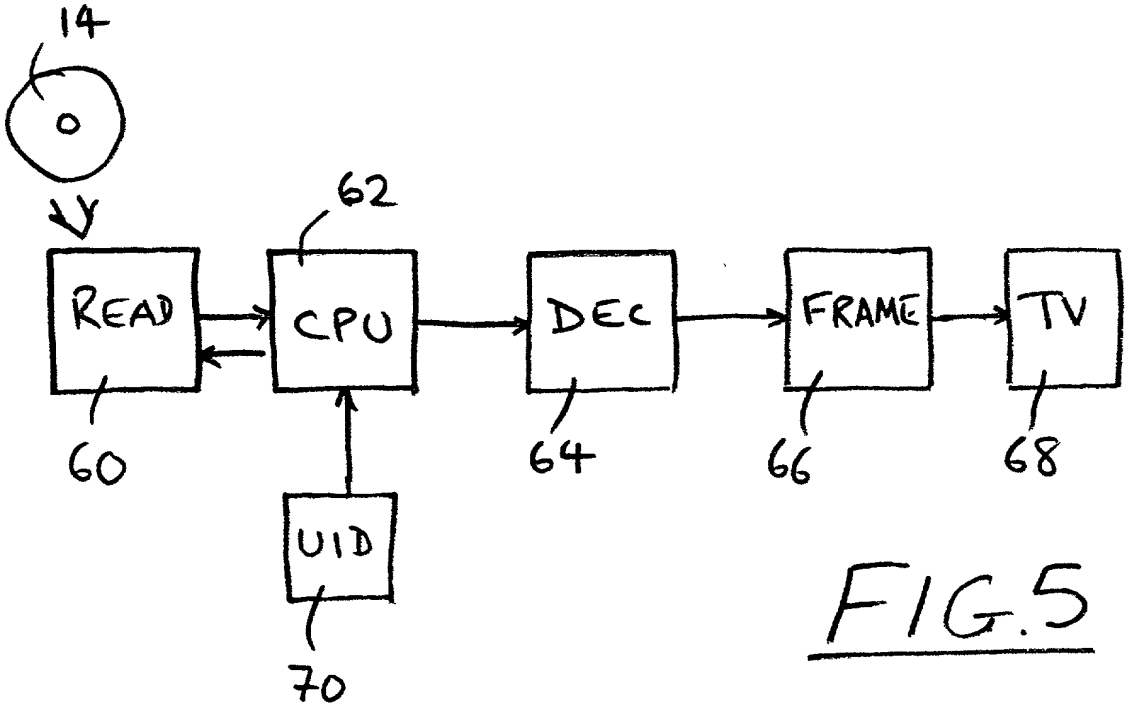

14
62
READ
CPU
DEC
FRAME
TV
60
64
66
68
UID
70

FIG.5

DECLARATION AND POWER OF ATTORNEY

Sole/Joint

Attorney's Docket No: PHB34200US

As a below named inventor, I hereby declare that:
My residence, post office address and citizenship are as stated below next to my name
I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

*ENCODED VIDEO SIGNAL FORMATTING

the specification of which (check one)

[X] is attached hereto

[] was filed on as Application Serial No: and was amended on

..... (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.
I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56 (a).
I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

PRIOR FOREIGN APPLICATION(S)

COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY Claimed Under 35 U.S.C. 119
GREAT BRITAIN	9721662.6	14-10-1997	Yes X No
			Yes No

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35 United States Code §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

PRIOR UNITED STATES APPLICATION(S)

APPLICATION SERIAL NUMBER	FILING DATE	STATUS (PATENTED, PENDING, ABANDONED)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

Jack E. Haken, Reg. No 26,902
Algy Tamoshunas, Reg. No 27,677

SEND CORRESPONDENCE TO:	DIRECT TELEPHONE CALLS TO: (Name and telephone number)
Corporate Patent Counsel U.S. Philips Corporation 580 White Plains Road Tarrytown, New York 10591	(914) 332-0222

Dated: 8 Sept 1998		Inventor's Signature: Octavius J Morris		
FULL NAME OF INVENTOR:	Last name: MORRIS	First Name: Octavius	Middle Name: J.	
RESIDENCE & CITIZENSHIP	City: REDHILL	State or Foreign Country: SURREY, UK	Country of Citizenship: GREAT BRITAIN	
POST OFFICE ADDRESS	Street & No: HAZELHURST COTTAGE,	City: FULLERS WOOD LANE	State or Country: REDHILL, UK	Zip Code: RH1 4EC

Dated: 8TH SEPTEMBER 1998		Inventor's Signature: Timothy J Everett		
FULL NAME OF INVENTOR:	Last name: EVERETT	First Name: Timothy	Middle Name: J.	
RESIDENCE & CITIZENSHIP	City: THAKEHAM	State or Foreign Country: UNITED KINGDOM	Country of Citizenship: GREAT BRITAIN	
POST OFFICE ADDRESS	Street & No: THRUMS, STORRINGTON RD.	City: THAKEHAM	State or Country: U.K.	Zip Code: RH20 3EQ

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of Atty. Docket

OCTAVIUS J. MORRIS ET AL PHB 34,200

Serial No.

Filed: CONCURRENTLY

ENCODED VIDEO SIGNAL FORMATTING

Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20231

APPOINTMENT OF ASSOCIATES

Sir:

The undersigned Attorney of Record hereby revokes all prior appointments (if any) of Associate Attorney(s) or Agent(s) in the above-captioned case and appoints:

Laurie E. Gathman (Registration No. 37,520)

c/o U.S. PHILIPS CORPORATION, Intellectual Property Department, 580 White Plains Road, Tarrytown, New York 10591, his Associate Attorney(s)/Agent(s) with all the usual powers to prosecute the above-identified application and any division or continuation thereof, to make alterations and amendments therein, and to transact all business in the Patent and Trademark Office connected therewith.

ALL CORRESPONDENCE CONCERNING THIS APPLICATION AND THE LETTERS PATENT WHEN GRANTED SHOULD BE ADDRESSED TO THE UNDERSIGNED ATTORNEY OF RECORD.

Respectfully,

Jack E. Haken, Reg. 26,902
Attorney of Record

Dated at Tarrytown, New York
on October 14, 1998.

S:\GA\APPASOC.GA